MTHRIL

```
MM      MM  TTTTTTTTTT  HH        HH   CCCCCCCC    SSSSSSSS   IIIIII   NN       NN   CCCCCCCC    000000
MM      MM  TTTTTTTTTT  HH        HH   CCCCCCCC    SSSSSSSS   IIIIII   NN       NN   CCCCCCCC    000000
MMMM  MMMM      TT      HH        HH   CC                SS       II   NN       NN   CC          00      00
MMMM  MMMM      TT      HH        HH   CC                SS       II   NNNN     NN   CC          00      00
MM  MM  MM      TT      HH        HH   CC                SS       II   NNNN     NN   CC          00      00
MM      MM      TT      HHHHHHHHHHHH   CC            SSSSSS       II   NN  NN   NN   CC          00      00
MM      MM      TT      HHHHHHHHHHHH   CC            SSSSSS       II   NN  NN   NN   CC          00      00
MM      MM      TT      HH        HH   CC                SS       II   NN    NNNN   CC          00      00
MM      MM      TT      HH        HH   CC                SS       II   NN    NNNN   CC          00      00
MM      MM      TT      HH        HH   CC                SS       II   NN       NN   CC          00      00
MM      MM      TT      HH        HH   CCCCCCCC    SSSSSSS    IIIIII   NN       NN   CCCCCCCC    000000
MM      MM      TT      HH        HH   CCCCCCCC    SSSSSSS    IIIIII   NN       NN   CCCCCCCC    000000
```

```
LL            IIIIII    SSSSSSSS
LL            IIIIII    SSSSSSSS
LL              II    SS
LL              II    SS
LL              II    SS
LL              II    SS
LL              II        SSSSSS
LL              II        SSSSSS
LL              II            SS
LL              II            SS
LL              II            SS
LL              II            SS
LLLLLLLLLL   IIIIII    SSSSS
LLLLLLLLLL   IIIIII    SSSSSSSS
```

MTH$CSINCOS
1-002
COMPLEX SINE AND COSINE
M 10
16-SEP-1984 01:12:16 VAX/VMS Macro V04-00   Page 1
6-SEP-1984 11:21:26 [MTHRTL.SRC]MTHCSINCO.MAR;1   (1)

```
0000      1              .TITLE  MTH$CSINCOS    COMPLEX SINE AND COSINE
0000      2              .IDENT  /1-002/        ; File: MTHCSINCO.MAR
0000      3
0000      4 ;
0000      5 ;*********************************************************************
0000      6 ;*                                                                   *
0000      7 ;*   COPYRIGHT (c) 1978, 1980, 1982, 1984 BY                         *
0000      8 ;*   DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASSACHUSETTS.          *
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0000     19 ;*   AND  SHOULD  NOT  BE  CONSTRUED AS  A COMMITMENT BY DIGITAL EQUIPMENT *
0000     20 ;*   CORPORATION.                                                     *
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0000     22 ;*   DIGITAL ASSUMES NO RESPONSIBILITY FOR THE USE  OR  RELIABILITY OF ITS *
0000     23 ;*   SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.          *
0000     24 ;*                                                                   *
0000     25 ;*                                                                   *
0000     26 ;*********************************************************************
0000     27
0000     28 ;
0000     29 ; FACILITY: MATH LIBRARY
0000     30 ;++
0000     31 ; ABSTRACT:
0000     32 ;       Return the SINE of a complex number
0000     33 ;       Return the COSINE of a complex number
0000     34 ;
0000     35 ;
0000     36 ;--
0000     37 ;
0000     38 ; VERSION: 0
0000     39 ;
0000     40 ; HISTORY:
0000     41 ;
0000     42 ; AUTHOR:
0000     43 ;       Jonathan M. Taylor, 19-JUL-77: Version 0
0000     44 ;
0000     45 ; MODIFIED BY:
0000     46 ;
0000     47 ;
0000     48 ;
```

```
            0000    50              .SBTTL   HISTORY        ; Detailed Current Edit History
            0000    51
            0000    52
            0000    53  ; Edit History for Version 0 of MTH$CSINCO
            0000    54  ;
            0000    55  ; 1-001 - Update version number and copyright notice.  The last edit
            0000    56  ; 1-002 - Add "_" to the PSECT directive.  JBS 21-DEC-78
            0000    57  ;          number in version 0 was 3.  JBS 16-NOV-78
```

```
          0000      59              .SBTTL  DECLARATIONS
          0000      60
          0000      61 ;
          0000      62 ; INCLUDE FILES:
          0000      63 ;       OERR.MAR
          0000      64
          0000      65 ;
          0000      66 ; EXTERNAL SYMBOLS:
          0000      67        .GLOBL  MTH$SIN_R4
          0000      68        .GLOBL  MTH$COS_R4
          0000      69        .GLOBL  MTH$EXP_R4
          0000      70
          0000      71 ;
          0000      72 ; MACROS:
          0000      73 ;       NONE
          0000      74
          0000      75 ;
          0000      76 ; PSECT DECLARATIONS:
00000000  0000      77        .PSECT  _MTH$CODE        PIC, SHR, LONG, EXE, NOWRT
          0000      78
          0000      79 ;
          0000      80 ; EQUATED SYMBOLS:
00000004  0000      81        argadr =        4        ; offset from AP of arg addr
          0000      82
          0000      83 ;
          0000      84 ; OWN STORAGE:
          0000      85 ;       NONE
```

MTH$CSINCOS
1-002

C 11

COMPLEX SINE AND COSINE
MTH$CSIN - COMPLEX SINE

16-SEP-1984 01:12:16   VAX/VMS Macro V04-00   Page   4
6-SEP-1984 11:21:26   [MTHRTL.SRC]MTHCSINCO.MAR;1   (4)

```
                    0000    87              .SBTTL  MTH$CSIN - COMPLEX SINE
                    0000    88
                    0000    89      ;++
                    0000    90      ; FUNCTIONAL DESCRIPTION:
                    0000    91      ;
                    0000    92      ;       MTH$CSIN computes the SINE of a COMPLEX number (r, i) as
                    0000    93      ;
                    0000    94      ;       result = (SIN(r) * COSH(i), COS(r) * SINH(i))
                    0000    95      ;
                    0000    96      ; CALLING SEQUENCE:
                    0000    97      ;       Sine.wfc.v       = MTH$CSIN(arg.rfc.r)
                    0000    98      ;
                    0000    99      ;
                    0000   100      ; INPUT PARAMETERS:
                    0000   101      ;       The one input parameter is the address of a COMPLEX number (r, i),
                    0000   102      ;       where r and i are both single-precision floating point values.
                    0000   103      ;
                    0000   104      ; IMPLICIT INPUTS:
                    0000   105      ;       NONE
                    0000   106      ;
                    0000   107      ; OUTPUT PARAMETERS:
                    0000   108      ;       NONE
                    0000   109      ;
                    0000   110      ; IMPLICIT OUTPUTS:
                    0000   111      ;       NONE
                    0000   112      ;
                    0000   113      ; COMPLETION CODES:
                    0000   114      ;       NONE
                    0000   115      ;
                    0000   116      ; SIDE EFFECTS:
                    0000   117      ;       Signals:              Reserved Operand if r or i are invalid (-0.0)
                    0000   118      ;                             MTH$_SINSIGLOS if |r| > 2*PI*2**31.
                    0000   119      ;                             Floating Overflow if i > 88.028.
                    0000   120      ;
                    0000   121      ;--
                    0000   122
                    0000   123
               00FC 0000   124              .ENTRY  MTH$CSIN,        ^M<R2,R3,R4,R5,R6,R7>
 00000025'EF     16 0002   125              JSB     WORKER                ; R0 = SIN(r)
                    0008   126                                            ; R1 = COS(r)
                    0008   127                                            ; R2 = SINH(i)
                    0008   128                                            ; R3 = COSH(i)
   50   53   44   0008   129              MULF    R3, R0                ; R0 = SIN(r) * COSH(i)
   51   52   44   000B   130              MULF    R2, R1                ; R1 = COS(r) * SINH(i)
             04   000E   131              RET
```

MTH$CSINCOS
1-002

D 11

COMPLEX SINE AND COSINE
MTH$CCOS - COMPLEX COSINE

16-SEP-1984 01:12:16   VAX/VMS Macro V04-00   Page   5
 6-SEP-1984 11:21:26   [MTHRTL.SRC]MTHCSINCO.MAR;1   (5)

```
                         000F   133              .SBTTL  MTH$CCOS - COMPLEX COSINE
                         000F   134
                         000F   135   ;++
                         000F   136   ; FUNCTIONAL DESCRIPTION:
                         000F   137   ;
                         000F   138   ;       MTH$CCOS computes the COSINE of COMPLEX number (r, i) as follows:
                         000F   139   ;
                         000F   140   ;       result = (COS(r) * COSH(i), -SIN(r) * SINH(-i))
                         000F   141   ;
                         000F   142   ; CALLING SEQUENCE:
                         000F   143   ;       Cosine.wfc.v    = MTH$CCOS (arg.rfc.r)
                         000F   144   ;
                         000F   145   ;
                         000F   146   ; INPUT PARAMETERS:
                         000F   147   ;       The one input parameter is the address of a COMPLEX number (r, i),
                         000F   148   ;       where r and i are both single-precision floating point values.
                         000F   149   ;
                         000F   150   ; IMPLICIT INPUTS:
                         000F   151   ;       NONE
                         000F   152   ;
                         000F   153   ; OUTPUT PARAMETERS:
                         000F   154   ;       NONE
                         000F   155   ;
                         000F   156   ; IMPLICIT OUTPUTS:
                         000F   157   ;       NONE
                         000F   158   ;
                         000F   159   ; COMPLETION CODES:
                         000F   160   ;       NONE
                         000F   161   ;
                         000F   162   ; SIDE EFFECTS:
                         000F   163   ;       Signals:            Reserved Operand if r or i are invalid (-0.0)
                         000F   164   ;                           MTH$_SINSIGLOS if |r| > 2*PI*2**31.
                         000F   165   ;                           Floating Overflow if i > 88.028.
                         000F   166   ;
                         000F   167   ;--
                         000F   168
                         000F   169
                   00FC  000F   170              .ENTRY  MTH$CCOS,       ^M<R2,R3,R4,R5,R6,R7>
      00000025'EF    16  0011   171              JSB     WORKER          ; R0 = SIN(r)
                         0017   172                                      ; R1 = COS(r)
                         0017   173                                      ; R2 = SINH(i)
                         0017   174                                      ; R3 = COSH(i)
         53   51   44   0017   175              MULF    R1, R3          ; R3 = COS(r) * COSH(i)
         50   50   52   001A   176              MNEGF   R0, R0          ; R0 = -SIN(r)
   51   52   50   45   001D   177              MULF3   R0, R2, R1      ; R1 = -SIN(r) * SINH(i)
         50   53   D0   0021   178              MOVL    R3, R0          ; R0 = COS(r) * COSH(i)
                   04  0024   179              RET
```

MTH$CSINCOS
1-002
E 11
COMPLEX SINE AND COSINE
WORKER - do all the work
16-SEP-1984 01:12:16   VAX/VMS Macro V04-00   Page   6
6-SEP-1984 11:21:26   [MTHRTL.SRC]MTHCSINCO.MAR;1   (6)

```
                        0025    181              .SBTTL  WORKER - do all the work
                        0025    182
                        0025    183      ;+
                        0025    184      ; Setup error handler
                        0025    185      ; Compute:
                        0025    186      ;         R0 = SIN(r)
                        0025    187      ;         R1 = COS(r)
                        0025    188      ;         R2 = SINH(i)
                        0025    189      ;         R3 = COSH(i)
                        0025    190      ;-
                        0025    191
                        0025    192  WORKER:
                        0025    193              MTH$FLAG_JACKET                 ; set up error handler
  6D  00000000'GF  9E   0025              MOVAB   G^MTH$$JACKET_HND, (FP)
                        002C                                                    ; set handler address to jacket
                        002C                                                    ; handler
                        002C
      50   04 AC   D0   002C    194              MOVL    argadr(AP), R0          ; R0 -> (r, i)
      50   04 A0   50   0030    195              MOVF    4(R0), R0               ; R0 = i
        00000000'EF  16 0034    196              JSB     MTH$EXP_R4              ; R0 = EXP(i)
  51   08   50   47   003A    197              DIVF3   R0, #1.0, R1            ; R1 = EXP(-i)
                        003E    198
  55   50   51   43   003E    199              SUBF3   R1, R0, R5              ; R5 = EXP(i) - EXP(-i)
        55   00   44   0042    200              MULF    #0.5, R5                ; R5 = (EXP(i) - EXP(-i))/2
                        0045    201
  56   50   51   41   0045    202              ADDF3   R1, R0, R6              ; R6 = EXP(i) + EXP(-i)
        56   00   44   0049    203              MULF    #0.5, R6                ; R6 = (EXP(i) + EXP(-i))/2
                        004C    204
      50   04 BC   50   004C    205              MOVF    @argadr(AP), R0         ; R0 = r
        00000000'EF  16 0050    206              JSB     MTH$COS_R4              ; R0 = COS(r)
        57   50   D0   0056    207              MOVL    R0, R7                  ; R7 = COS(r)
                        0059    208
      50   04 BC   50   0059    209              MOVF    @argadr(AP), R0         ; R0 = r
        00000000'EF  16 005D    210              JSB     MTH$SIN_R4              ; R0 = SIN(r)
                        0063    211
        51   57   D0   0063    212              MOVL    R7, R1                  ; R1 = COS(r)
        52   55   D0   0066    213              MOVL    R5, R2                  ; R2 = SINH(i)
        53   56   D0   0069    214              MOVL    R6, R3                  ; R3 = COSH(i)
                        006C    215
              05   006C    216              RSB
                        006D    217
                        006D    218
                        006D    219
                        006D    220              .END
```

```
ARGADR            = 00000004
MTH$$JACKET_HND     ********  X   01
MTH$CCOS            0000000F RG   01
MTH$COS_R4          ******** G    00
MTH$CSIN            00000000 RG   01
MTH$EXP_R4          ******** G    00
MTH$SIN_R4          ******** G    00
WORKER              00000025 R    01
```

+-------------------+
! Psect synopsis !
+-------------------+

PSECT name	Allocation		PSECT No.	Attributes											
. ABS .	00000000 (	0.)	00 (0.)	NOPIC	USR	CON	ABS	LCL	NOSHR	NOEXE	NORD	NOWRT	NOVEC	BYTE
_MTH$CODE	0000006D (	109.)	01 (1.)	PIC	USR	CON	REL	LCL	SHR	EXE	RD	NOWRT	NOVEC	LONG

+-----------------------------+
! Performance indicators !
+-----------------------------+

Phase	Page faults	CPU Time	Elapsed Time
Initialization	33	00:00:00.09	00:00:01.38
Command processing	126	00:00:00.60	00:00:03.69
Pass 1	84	00:00:00.72	00:00:02.16
Symbol table sort	0	00:00:00.00	00:00:00.00
Pass 2	51	00:00:00.59	00:00:01.94
Symbol table output	2	00:00:00.01	00:00:00.37
Psect synopsis output	2	00:00:00.02	00:00:00.01
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	300	00:00:02.06	00:00:09.56

The working set limit was 900 pages.
3332 bytes (7 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 8 non-local and 0 local symbols.
280 source lines were read in Pass 1, producing 14 object records in Pass 2.
1 page of virtual memory was used to define 1 macro.

+-----------------------------+
! Macro library statistics !
+-----------------------------+

Macro library name	Macros defined
_255DUA28:[SYSLIB]STARLET.MLB;2	0

0 GETS were required to define 0 macros.

There were no errors, warnings or information messages.

MACRO/ENABLE=SUPPRESSION/DISABLE=(GLOBAL,TRACEBACK)/LIS=LIS$:MTHCSINCO/OBJ=OBJ$:MTHCSINCO MSRC$:MTHJACKET/UPDATE=(ENH$:MTHJACKET)+MS

MTHCVTDG
.LIS

MTHDACOS
.LIS

MTHCGABS
.LIS

MTHCDSINC
.LIS

MTHCLOG
.LIS

MTHDASIN
.LIS

MTHCGLOG
.LIS

MTHCONVER
.LIS

MTHDATAN
.LIS

MTHCSQRT
.LIS

MTHCEXP
.LIS

MTHCGSQRT
.LIS

MTHCGEXP.
.LIS

MTHCSINCO
.LIS

MTHCONJG
.LIS

MTHCDSQRT
.LIS

MTHCGSINC
.LIS

MTHCOSH
.LIS